GROWING GRAIN SORGHUMS IN THE SAN ANTONIO DISTRICT OF TEXAS

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A SHORTAGE of grain feed is of common occurrence on the farms in the San Antonio district of Texas. This results from planting an insufficient acreage of grain crops and from the fact that farmers rely too much upon Indian corn for grain production. Corn produces a relatively small yield per acre under the conditions existing in this district and a complete failure of the crop often occurs. A grain crop that is more dependable than corn is urgently needed.

Experiments at the San Antonio Field Station during the past eight years indicate the possibility of making grain sorghum a successful crop in that district. Grain sorghum is a much surer crop in unfavorable years than corn, and it yields fully as much feed in favorable years. The principal reason why grain sorghum has not been more extensively planted in this district is its frequent failure to produce grain, due to blasting, or sterility. This blasting is caused by a small gnatlike fly, the sorghum midge. The results of the observations and experiments at San Antonio show that by using early varieties and special cultural methods sorghum can be made a dependable grain crop in spite of the midge.

The points of special significance to be observed are early seeding and the use of quick-maturing varieties.

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CONTENTS.

THE NEED FOR A DEPENDABLE GRAIN FEED CROP.

THE SAN ANTONIO region of Texas often experiences a shortage of grain feed on farms. This is a result of planting an insufficient acreage to grain crops and of placing too great dependence upon Indian corn for grain production. Corn makes a small yield per acre under ordinary conditions in this district, and a complete failure of the crop is not infrequent. There is urgent need for a more dependable grain crop than corn.

ADAPTABILITY OF VARIOUS GRAIN CROPS.

In an attempt to determine the adaptability of various grain crops to the local conditions, the San Antonio Experiment Farm has tested many grains, including a large number of varieties of corn, oats, and grain sorghums. These varieties were all grown without irrigation, and the results are applicable to farming conditions generally in that district. A comparison of the yields of corn, oats, and Dwarf milo (the most satisfactory grain-sorghum variety so far tested) is given in Table I, which shows the average yields of corn, oats, and Dwarf milo in the rotation experiments for a seven-year period.

TABLE I.—*Average yields of oats, corn, and Dwarf milo in the rotation experiments at the San Antonio Experiment Farm, 1911 to 1917, inclusive.*

Year.	Yield per acre (bushels).			Year.	Yield per acre (bushels)		
	Oats.	Corn.	Milo.		Oats.	Corn.	Milo.
1911	8.5	10.6	32.0	1916	4.5	8.5	8.0
1912	26.8	34.1	40.0	1917	6.6	10.7	19.3
1913	11.7	34.9	47.7				
1914	15.7	52.6	43.2	Average for 7 years (1911 to 1917)	13.3	26.0	30.4
1915	19.5	30.3	22.8				

It is seen that with the exception of three seasons, 1913, 1915, and 1916, Dwarf milo has outyielded corn very noticeably and has outyielded oats even more. The average yield per acre of oats for seven years, 1911 to 1917, inclusive, was 13.3 bushels; of corn, 26 bushels; and of milo, 30.4 bushels. Stated in other terms, milo has yielded 16 per cent more grain than corn and 300 per cent more grain than oats. These percentages are calculated on the basis of pounds of thrashed or shelled grain. The years in which the yields of corn exceeded the yields of milo were those which were extremely favorable to the corn crop or in which poor stands and the late planting of milo resulted in excessive injury to the milo by the sorghum midge. It is in relatively unfavorable seasons that milo shows a marked superiority over corn, and these are the seasons when a shortage of grain feed on farms is most likely to occur. It is the sureness of production of the grain sorghums when seeded sufficiently early which adapts them to the irregular and uncertain seasonal conditions of the San Antonio district. The results obtained at the experiment farm and by farmers who have grown the crop appear to show that grain sorghum can be made a very satisfactory grain crop when the best varieties are used and proper cultural methods are followed.

COMPARISON OF THE HABITS OF CORN AND GRAIN SORGHUM.

Corn is not a safe crop under San Antonio conditions, mainly because of its exacting water requirements. The crop requires for its best development a very large supply of soil moisture during a very short period of its growth. If a generous moisture supply is not available at this critical time, failure to mature a full crop of grain results. Corn has very little ability to adjust its growth to conditions and wait for rain. Grain sorghum, on the other hand, has this ability. During a severe drought, the plants sometimes appear to be practically dead, but they commonly are revived by rain and make a good crop of grain. Under the same circumstances corn never recovers, no matter how favorable subsequent growing conditions may be.

CONDITIONS AFFECTING GRAIN-SORGHUM PRODUCTION IN THE SAN ANTONIO DISTRICT.

One of the principal reasons why grain sorghum has not been planted more extensively in the San Antonio district is its frequent failure to produce grain, due to blasting, or sterility. The cause of this difficulty was discovered at the Louisiana Agricultural Experiment Station, Baton Rouge, and at the San Antonio Experiment Farm several years ago to be a small gnatlike fly, the sorghum midge.[1] This fact, however, is not yet so widely known by farmers

[1] Ball, C. R. The sorghum midge. *In* Science, n. s., v. 27, no. 681, p. 114–115. 1908. Ball, C. R., and Hastings, S. H. Grain-sorghum production in the San Antonio region of Texas. U. S. Dept. Agr., Bur. Plant Indus. Bul. 237, 30 p., 4 fig. 1912.

as it should be, many still holding the old view that blasting is caused by rain at flowering time. The sorghum midge is very generally distributed throughout the San Antonio district, and there is practically never a season when the insect is not present for some time. If any of the sorghum crops are in the right condition when the midge appears, the insect will damage the crop in varying degrees, ranging from slight injury to complete prevention of grain production.

THE SORGHUM MIDGE.[1]

The sorghum midge is a very small gnatlike fly, which passes the winter season in the cocooned larva stage. These larvæ are found in Johnson grass and sorghum heads which are left in fence corners, along roadsides, and in other places. On the approach of warm weather in the spring and when Johnson grass or sorghum begins heading, the larvæ change to pupæ, then to adults, which begin immediately a search for a place to deposit eggs. During the winter season a large proportion of the insects die from various causes, so that at the opening of spring only a comparatively small number of larvæ remain alive. As soon as any of the sorghum crops or the Johnson grass reaches the flowering stage, the female insects begin depositing eggs in the flowers. These eggs are deposited inside the inner glume adjacent to the ovary. They hatch into a pink or white grub, which lies next to the ovary or developing grain and absorbs the plant juices. The ovary shrinks and fails to develop normally and a sterile spikelet results. When the larva becomes fully developed, it changes to the pupa stage and finally emerges as an adult midge. Immediately after this emergence, copulation takes place, and the female midge begins a search for a place to deposit her eggs. She continues to deposit eggs throughout her short life and when the egg supply is exhausted dies. The life cycle is repeated, and this continues so long as the weather conditions are favorable and there is sorghum heading to furnish a place for depositing eggs. The life cycle, i. e., the time required for the adult to develop from a newly deposited egg, varies according to weather conditions from 14 days upward, the most rapid development occurring during the warmest weather.

The first midges appear when the Johnson grass or sorghum begins heading, and the insects continue to increase in numbers until their food supply is greatly reduced or exhausted. They are, therefore, found in greatest abundance sometime after the sorghum crops begin heading. They usually are present in varying numbers throughout the remainder of the season or until frost kills the host

[1] For a full discussion of the life history and habits of the insect, see Dean, W. H., The sorghum midge. *In* U. S. Dept. Agr., Bur. Ent. Bul. 85, p. 39–58, fig. 20–31, 2 pl. 1910.

plants. Due to the irregularity in their food supply, the insects appear in great numbers at irregular intervals throughout the summer, depending upon seasonal conditions. For that reason there are frequently periods during the summer when only slight injury is done to the sorghum crops by the midge. There is no way of knowing, however, when these periods will occur. On that account, sorghum that is flowering during the summer is in constant danger of a severe infestation, which will result in the complete failure of the seed crop.

EVADING THE SORGHUM MIDGE.

As there is no satisfactory way of combating the sorghum midge by treatment and as all sorghum varieties appear to be susceptible to its attacks, the only known method of dealing with the insect is to evade it. Fortunately, its life habits are such as to make evasion possible. If the sorghum plants flower at times when the midges are least numerous and consequently unable to do serious damage, a satisfactory seed crop may be produced. Observations upon the behavior of the sorghums in the San Antonio district revealed the fact that when quick-maturing varieties were seeded early and consequently matured early, the sorghum midge failed to damage the grain crop seriously. This led to the use of early varieties and the practice of early seeding at the San Antonio field station. Since the adoption of these precautions, a complete failure of the crop has not been experienced.

CULTURE OF GRAIN SORGHUMS.

It appears from the foregoing that a means of overcoming the most serious obstacle to grain-sorghum production in the San Antonio district has been found. It is believed that the best and surest means of increasing grain production in the region is more extensive planting of this crop. It is desirable, therefore, to discuss the best varieties for the district and to outline briefly the necessary cultural methods to employ in the production of the crop.

BEST VARIETIES FOR THE DISTRICT.

The testing of grain-sorghum varieties has been conducted at the San Antonio field station since 1909. All varieties in commercial production in the United States and a great many which have never been grown generally by farmers have been tried. The great importance of early maturity has already been emphasized. Early maturity is secured best by the early seeding of a quick-maturing variety. The results of experiments at the San Antonio field station show that Dwarf milo (fig. 1) and feterita (fig. 2) are the best varieties for

grain production in that district. The grain yields of Dwarf milo have averaged approximately 25 per cent more than those of feterita. Both varieties require practically the same time for maturity. Dwarf milo does not grow so tall as feterita and is usually more uniform in growth and height; hence, it is less difficult to harvest and thrash. It is also apparently less susceptible to bird damage, probably on account of the softness and lack of tannin of the feterita grain. Neither does it shatter nearly so rapidly in the field, and consequently it suffers less from delayed harvesting. The advantages of Dwarf milo over feterita appear sufficiently great to recommend it unconditionally wherever the principal object is grain production.

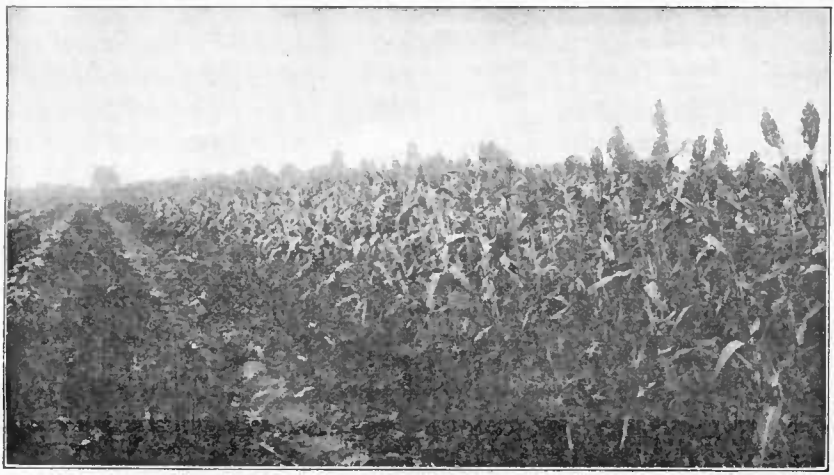

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FIG. 1.—A plat of Dwarf milo at the San Antonio Experiment Farm. This variety has given the best results of all the grain sorghums tested at this place.

On account of its taller growing habit, feterita may produce a slightly larger quantity of roughage than milo. However, the larger quantity of grain in milo fodder would probably increase its feeding value to such a degree as to make it superior to feterita, even for fodder or silage. The stalks of both milo and feterita are rather woody and dry and are inferior in palatability and feeding value to kafir, but on account of the lateness of maturity of the kafirs and consequently their greater susceptibility to sorghum-midge damage, they usually produce less grain than either Dwarf milo or feterita. It is believed that when it is possible and desirable to plant grain sorghum from July 1 to 15, kafir is the most desirable variety for such planting. Under these conditions of planting, the crop would reach maturity late enough in the fall to escape serious sorghum-midge damage, and it might even yield a greater amount of grain than milo or feterita. In case of subsequent drought, other unfavor-

able growing conditions, or frost before maturity, the forage of kafir would be more valuable and probably in larger quantity than that of either milo or feterita. The best variety for such planting is that known as Early or Sunrise kafir. This is as early as Dawn or Dwarf kafir, produces a larger stalk and a greater total yield of fodder, and is about equal in grain production.

In order to make possible early seeding, which has been emphasized as of greatest importance, the early and thorough preparation of the seed bed is necessary. The seeds of sorghum are rela-

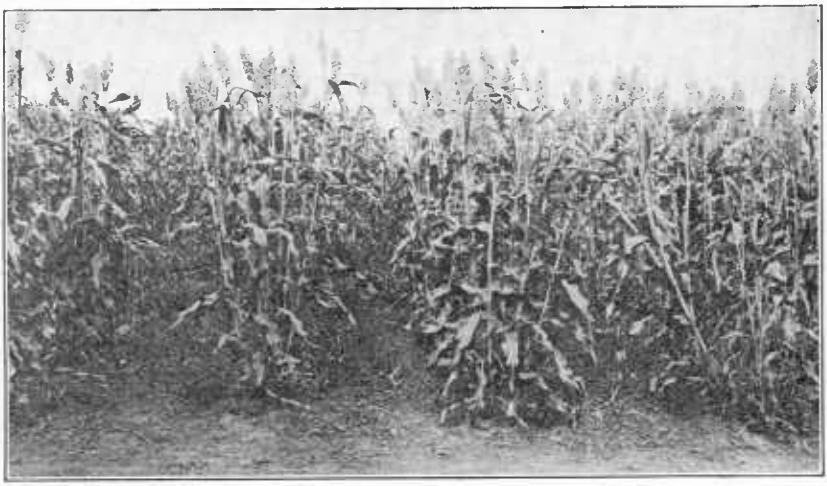

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FIG. 2.—A plat of feterita at the San Antonio Experiment Farm. While this variety of grain sorghum has not yielded quite as well as Dwarf milo, it has proved to be well adapted to conditions in the San Antonio district.

PREPARATION OF THE LAND.

tively small and must not be planted too deep or in cold ground, on account of danger of decay and a consequent poor stand. The seed bed should be smooth, firm, and moist, in order that the seed may be planted in moist soil and covered to a uniform depth. This is necessary so that rapid and uniform germination may take place and a good stand secured. Strong, vigorous, rapid-growing plants will result, which will develop earlier and more uniformly than if planted on a poorly prepared seed bed.

If possible, the land on which grain sorghum is to be planted should be plowed early the preceding fall, as this will facilitate the storing in the soil of moisture from the fall and winter rains. The land should be harrowed several times during the winter, particularly after rains, to maintain a soil mulch and to keep the soil granular, so that it may readily absorb the subsequent rainfall. Such har-

rowing will break the clods, smooth and firm the soil, and develop a good seed bed.

TIME OF SEEDING.

Observations and experiments at the San Antonio field station indicate that seeding should be done from March 5 to 20, and never later than April 1 if the best results are to be secured. In occasional years, late spring frosts may injure or even kill the seedlings when planting is done very early, making replanting necessary, but the advantage in early seeding will more than offset the risk of such damage. Aside from the danger of frost injury, extremely early seeding, as in February, has been found to be undesirable, as the sorghum seeds decay quickly under unfavorable conditions and poor and nonuniform stands result. Moreover, the growth of the plants is often delayed by cold weather, and later seedings have been observed to reach maturity practically as soon as the crops resulting from extremely early seeding. As such a small quantity of seed is required it is recommended that seeding be done as soon as weather conditions permit after March 5 and if a poor stand is obtained that reseeding be done not later than April 1. These recommendations apply particularly where Dwarf milo or feterita is the variety grown. In addition to evading the injury of the midge, early seeding will enable the crop to reach maturity before the hot, dry weather of summer.

In occasional years, as in 1917, sorghum seeded later than April 1 may not be materially injured by the sorghum midge. Therefore, when early seeding is impossible on account of seasonal conditions, later seeding may be done. It should always be borne in mind, however, that complete failure of the grain is likely to occur. In such a case, the crop may be utilized for roughage. Observations and preliminary experiments indicate that when sorghums reach maturity very late in the season, the chances for the development of the seed are much better than when they mature during midsummer. Therefore, it is recommended that early seeding, before April 1, be employed whenever possible, and late seeding, that is, in late July, so that the late crop will begin blooming about October 1, be practiced when it is desired to grow grain sorghum for a fall crop.

METHOD OF SEEDING.

The grain sorghums may be seeded with an ordinary 1-row or 2-row combined corn and cotton planter equipped with the small-hole plates usually furnished with such planters. The number and sizes of holes to use in these plates will depend upon the size of the seed and the thickness with which it is desirable to seed. This will de-

pend upon the variety used, the seed of kafir being much smaller than milo or feterita seed. It is also sometimes necessary to seed feterita somewhat more thickly than milo, since the seed is often of low vitality. If hand thinning is to be done, thick seeding can be practiced. This will insure a better and more uniform stand, but the expense and objections to hand thinning must be taken into consid-

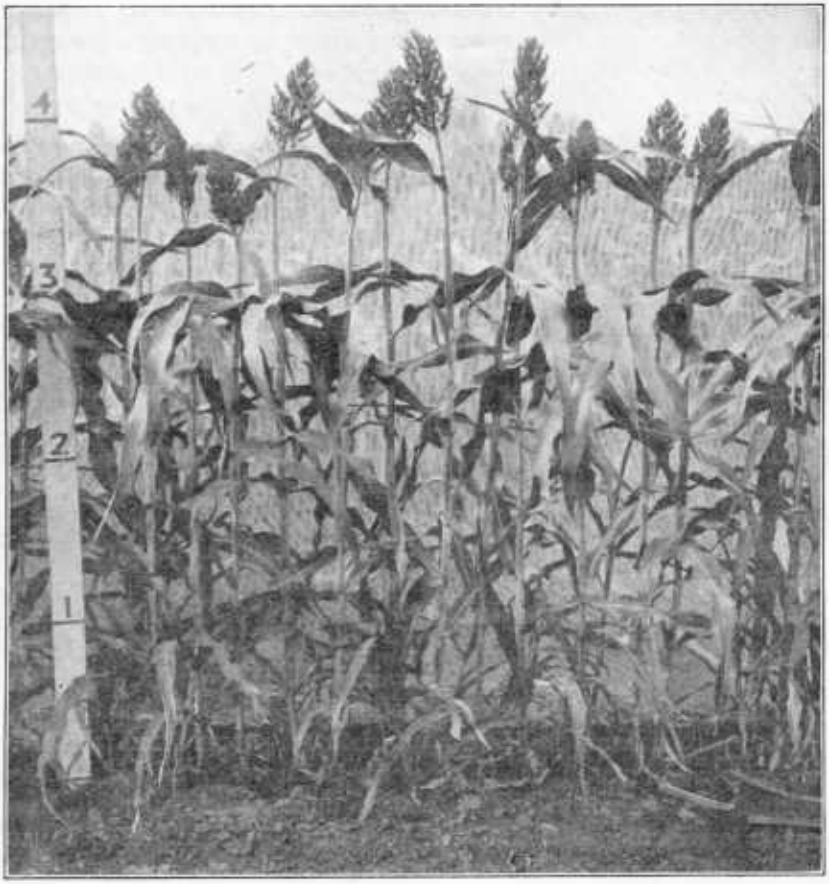

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FIG. 3.—Close-spaced milo plants, showing almost total freedom from tillers and resulting high uniformity, at the San Antonio Experiment Farm.

eration. When early seeding is practiced seed should be distributed somewhat more thickly than it is desired to have the plants, inasmuch as some seed will fail to germinate. It is, of course, desirable to test the seed for germination, and in case the vitality of the seed is low the rate of seeding should be increased sufficiently to insure a good stand. The rate of seeding should be about 6 pounds per acre for milo, 6 to 8 pounds for feterita, and about 4 pounds for kafir.

Experiments indicate that the grain sorghums should be seeded in rows 3½ to 4 feet apart. The most desirable distance between the plants within the row depends somewhat upon the variety used, milo and feterita requiring somewhat closer spacing than kafir. The results of a series of experiments made at the San Antonio field station in 1913 and 1914 indicate that with Dwarf milo somewhat thicker seeding is desirable in that district than has ordinarily been advocated for other sections.[1] These experiments indicate that Dwarf milo plants should be from 3 to 4 inches apart in rows 4 feet apart. This relatively close spacing (fig. 3) resulted in less tillering, fewer pendent heads, more uniform and earlier maturity, and larger yields of grain.

The seed should be planted in moist soil and covered uniformly not more than 1½ inches deep. In order to make this possible when the surface soil may be dry and uneven, some sort of furrow opener to throw back the dry surface layer has been found advantageous. This has been accomplished at San Antonio by bolting a short piece of 2 by 4 timber to each side of the planter shoe. This arrangement has worked very satisfactorily and has made possible seeding under conditions of soil moisture which would not otherwise have been advisable. Seeding in shallow lister furrows may also be practiced.

CULTIVATION.

The crop may be cultivated in the same way and with the same implements as the corn crop. Cultivation should be started while the plants are small, in order to prevent the growth of weeds. It should be shallow, not more than about 3 inches deep. The operation may be repeated until the plants are too large to allow the cultivator to pass between the rows readily.

HARVESTING AND THRASHING.

The method of harvesting to be employed will depend upon the use to be made of the crop. The heads may be removed by cutting with a knife from the stalks standing in the field or the entire plant may be cut with a row binder, as shown in figure 4, or by hand. In either case, several days of curing are necessary before thrashing can be done. With varieties having a small proportion of stalk, such as Dwarf milo, the entire stalk can be put through the thrasher, or the heads may be removed with a cutter of some kind and they alone put through the thrasher. The heads may also be fed to live stock without thrashing, in much the same way as ear corn, although better results, except for sheep and poultry, are usually obtained

[1] Hastings, S. H. The importance of thick seeding in the production of milo in the San Antonio region. U. S. Dept. Agr. Bul. 188, 21 p., 9 fig. 1915.

when the sorghum grains are ground before feeding.[1] With certain kinds of grinders it is possible to grind the unthrashed heads, making what is commonly known as head chops. Thrashing is done with an ordinary grain separator, although, on account of the danger of cracking, it is desirable to reduce the speed of the cylinder to about 600 or 800 revolutions per minute and to remove some of the concave teeth. Reducing the speed of the cylinder is particularly necessary where the heads alone are put through the separator.

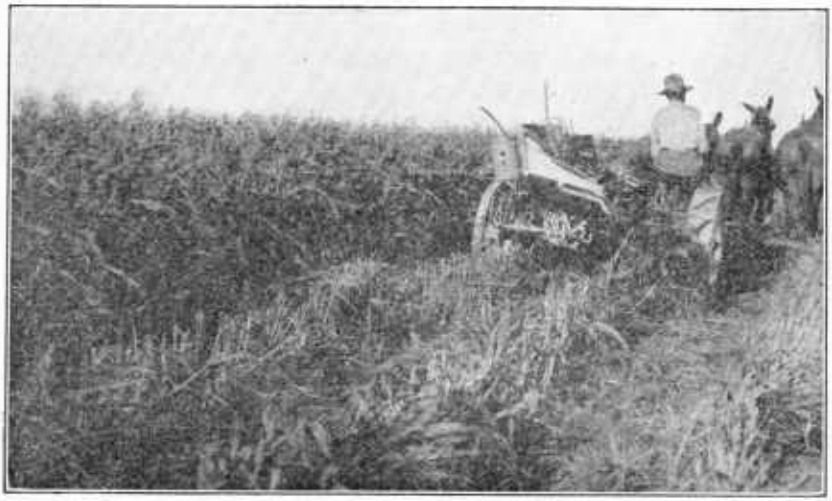

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FIG. 4.—Harvesting Dwarf milo with a row binder at the San Antonio Experiment Farm.

USE OF SORGHUM GRAIN.

Speaking generally, sorghum grain may be used for the same feeding purposes as Indian corn. All live stock relish it and make rapid and satisfactory gains when it is fed to them. The grain has also long been highly prized for poultry feeding. It may also be ground into meal and used for human food in the same way as corn meal, and the meal may be used as a substitute for a portion of the wheat flour in yeast bread.

[1] Scott, G. A. The feeding of grain sorghums to live stock. U. S. Dept. Agr. Farmers' Bul. 724, 14 p., 5 fig. 1916.